Molecular Relaxation Studies of Herbal Medicines

Synopsis

Submitted to

Swami Ramanand Teerth Marathwada University, Nanded

For the registration of the topic for

Doctor of Philosophy

in the subject of PHYSICS

(Faculty of Science)

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Introduction:

Materials are probably more significant in our culture for the purpose of human wellbeing.Materials have helped to advance a variety of technologies, including medical and health, information and communication, national security and space, transportation, structural materials, arts and literature, textiles, personal hygiene, agriculture and food science, and the environment. These cross-disciplinary connections between material sciences and other domains in the development of new materials and their applications must be thoroughly understood.

The material science is an important field of research which allows the characterization and development of new materials. It also provides novel ways in which we can use existing materials.The importance, classification and properties of materials are clearly explained in an article given by S.P. Pande and V. Singh [1].

In order to explore the underlying properties of materials one can use various spectroscopic techniques like Nuclear Magnetic Resonance (NMR) spectroscopy, Fourier Transform Infrared (FTIR) spectroscopy, Raman spectroscopy, Dielectric spectroscopy, gas chromatography and liquid chromatography are utilized.Among these, the dielectric spectroscopy is more advantageous as it explains the existence of inter and intra-molecular interactions in the materials and mixtures. Now aday’s herbal medicine has its own identity in the world. There is a need to investigate and document the qualities of herbal materials of interest to medicine from the perspective of their usage in medicine.

In the present research proposal, the dielectric spectroscopic study is chosen to be done for herbal medicines and Medicinal Plant extracts by investigating their dielectric relaxation parameters.The dielectric permittivity of a material determines the interaction of that material with electric fields. The frequency dependant complex permittivity relative to free space $\varepsilon^*(\omega) = \varepsilon'(\omega) - j\varepsilon''(\omega)$, is a complex term in which ε' (the real part) is known as dielectric permittivity, it is associated with the capability of energy storage in the material and ε'' (the imaginary part) is the dielectric loss factor and includes all losses, mainly those due to dipolar relaxation and ionic conduction.

Review of Literature:

The literature review for the present case reveals that the medicinal herbs and their extracts are utilized in the medicine directly or indirectly. There is a plethora of research work regarding the medicinal plants and their extracts. But there are no limitations for their study as there are innumerable varieties of medicinal plants worldwide. Some of the previously performed studies of herbal medicines and medicinal plant extracts are as follows:

The dielectric relaxation study helps us to understand the aging processes and the quality control of various agricultural products [2,3]. Abdul Jaleel A.H. et. al. [4]had performed a dielectric spectroscopic study regarding extracts of four herbal plants namely fenugreek, Swertia chirata, Gymnemasylvestre and Tephrosia putpurea. A.R. Kagdi et. al. had utilizedvarious quantities of ginger (Zingiber officinale) root extract prepare X-type BariumZinchexaferrite and studied their dielectric properties [5]. The quality detection investigations of herbal medicinal plants using Terahertz Spectroscopy and Imaging Techniques has been done by C. Han and their research team [6].S.R. Choudhari et. al. [7] studied the microwave dielectric behaviour of some ayurvedic medicines such as Ashokarishta, Punarnvarishta and Dashmularishta from Arishta group in the form of binary mixtures with Ethanol and Methanol.

At present, the largely contributing scientists in this research field are D. Bertolini[8],Y. D. Feldman[9-11],U.Kaatze[12-14], S.C.Mehrotra[15,16], R.J.Sengwa[17,18], V.A. Rana [19,20], A.C. Kumbharkhane[21-24], S.O. Nelson[25-30] etc.

Objectives of proposed work:

- To measure the refractive indices of associated herbal medicines and few medicinal plants extracts in liquid form.
- Measuring the complex permittivity of chosen medical plant extracts very precisely using the TDR technique.
- To study the effect of temperature on dielectric parameters of these materials.
- Determining the relaxation time, static dielectric permittivity, dielectric loss, activation enthalpy, and high-frequency dielectric permittivity by using suitable mathematical models.

Methodology to be adopted:

The Time Domain Reflectometry (TDR) is a powerful technique one can use to study molecular structures and their dynamics. The principle of working of this technique is as a fast-rising voltage pulse with a repetition frequency of a few kHz with the rising time of picoseconds is allowed to transmit through a coaxial line with 50 Ohm characteristic impedance. The co-axial cable of semi rigid copper with a flat end is to be used. Sampling oscilloscope monitors changes in the pulse after reflection from the end of the line. The reflected pulses are added and subtracted and then Fourier transformation has to be performed, resulting in raw spectra. The raw spectra may contain errors and spurious reflections whichcan be corrected using the calibration method to obtain complex permittivity spectra.

The refractive index of the liquid sample will be measured using Abbes' refractometer very precisely and the values of refractive indices will be utilized to compute dielectric permittivity at infinite frequency.

Importance of study/ society applications:

The following scientists are well known in this research field at national and international level:

International Status:

1. S O Nelson, US Department of Agriculture, Agricultural Research Service, Athens, GA 30604-5677, United States
2. N Shinyashiki, University of Tokyo, Tokyo, Japan
3. S Yagihara, University of Tokyo, Tokyo, Japan
4. S Sudo, Dept. of Physics, Tokyo City Univ. Tamazutsumi, Setagaya, Tokyo, Japan
5. A Cataldo, Universita di Lecce, via Monteroni, 73100 Lecce, Italy
6. Udo Kaatze, DrittesPhysikalischesInstitut Georg-August-Universitat Gottingen, Germany.
7. Yuri D Feldman, Department of Applied Physics, Hebrew University of Jerusalem, Jerusalem, Israel.

National Status:

1. S C Mehrotra, Dr. BAMU, Aurangabad, Maharashtra
2. R J Sengwa, JNV University, Jodhpur, Rajasthan

3. A C Kumbharkhane, SRTM University, Nanded, Maharashtra
4. V A Rana, Gujrat University, Ahmedabad, Gujrat

Significance of the study:

As the dielectric spectroscopic technique can be employed non-invasively, this technique is very important and effective for studying herbal medicines and medicinal plants. Dielectric spectroscopy provides quick and accurate frequency dependant permittivity spectra of the material under investigation.

Due to its accuracy, flexibility, large application conditions, and potential for automated measurement, reflectometry has become one of the most attractive methods for monitoring applications. This study is useful in order to explain the various relaxation processes in herbal medicines as well as their solutions. Dielectric relaxation parameters studied in this research work can be utilized for direct or indirect applications of these materials in designing the various medicines and pharmaceutical drugs which will be a future goal.

Work plan/ formulation and structure of study:

First Year: To perform literature survey and to prepare a theoretical background for the related research problem. Choosing an appropriate herbal medicines and medicinal plants to be studied.

Second Year: To study the dielectric dispersion of selected herbal medicines and medicinal plant extracts at different frequencies. To evaluate the dielectric properties such as static dielectric permittivity, relaxation time, dielectric permittivity at high frequencyof these systems.

Third Year: Dielectric information extracted from data analysis of these systems will be interpreted. These interpretations will be published by writing research papers or presenting the work in conference/seminars. Finally, write up thesis and complete the research work.

References:

[1] S.P. Pande, V. Singh, IJSR, ISSN: : 2319-7064,Vol. 6 Iss. 3 (2017) 433-441.

[2] S.M. Sabnis, K.S. Kanse, Y.S. Joshi, D.N. Rander, P.A. Bhadane, A.C. Kumbharkhane, 2nd International Conference on Technological Advancements in Computational Sciences (ICTACS), IEEE (2022) 228-235.

[3]S.M. Sabnis, D.N. Rander, K.S. Kanse, Y.S. Joshi,A.C. Kumbharkhane,Inf. Process. Agric. (2023) 1-12.

[4]Abdul Jaleel A.H, B.M. Abdullah, N. P Pawar, Y.H. Shaikh, IJRAR, Vol. 5, Iss. 4 (2018) 637-641.

[5] A.R. Kagdi, R.C. Pullar, S.S. Meena, R.B. Jotania, K.M. Batoo, J. Alloys Compd. 842 (2020) 1-10.

[6] C. Han, F. Qu, X. Wang, X. Zhai, J. Li,K. Yu, Y. Zhao, Crit. Rev. Anal. Chem. (2023) 1-15.

[7]S.R.Chaudhari, R.D.Chaudhari and J.B.Shinde (2010). Microwave Dielectric Behavior of Ayurvedic Medicines,Advanced Microwave Circuits and Systems, Vitaliy Zhurbenko (Ed.), ISBN: 978-953-307-087-2, InTech (2010).

[8]D. Bertolini, M.Cassettari, G. Salvetti, E. Tombari, Veronesi, Rev. Sci. Instrum., 61 (1990) 450.

[9]V. Raicu, Y.D. Feldman, in book: Dielectric Relaxation in Biological Systems Physical Principles, Methods, and Applications, ISBN: 978–0–19–968651–3.

[10]I. Popov, P.B. Ishai, A. Khamzin, Y.D. Feldman, Phys. Chem. Chem. Phys.,18 (20) (2016) pp. 13941-13953.

[11] L. Latypova,A. Puzenko, A. Bogdanova, Y.D. Feldman, 13th International Conference on Electromagnetic Wave Interaction with Water and Moist Substances (ISEMA), 2021.

[12]U. Kaatze, Y.D. Feldman, Meas. Sci. Technol. 17 (2006) R17–R35.

[13]U. Kaatze, J. Mol. Liq., 315 (2020) 113788.

[14]U. Kaatze, “Water: Why Is it So Special?”, IEEE2018.

[15]S.C. Mehrotra, V.A. Rana, A.D. Vyas, J. Mol. Liq., 102/1–3 (2002) 379–391

[16]B.G. Lone, S.C. Mehrotra et. al., J. Mol. Liq., 141 (2008) 47–53.

[17]R.J. Sengwa, S. Sankhla, N. Shinyashiki, J. Solution Chem., 37 (2008) 137–153.

[18] R.J. Sengwa, S. Choudhary, P.Dhatarwal, J. Mol. Liq., 225 (2017) 42–49.

[19] V.A. Rana, V.A. Pandit,J. Mol. Liq., (2020) 113673.

[20]N.S. Shah, P.S. Shah, V.A. Rana, Ionics, 21(12) (2015) 3217–3222.

[21] S.S. Kadam, K.S. Kanse, Y.S. Joshi, D.N. Rander, A.C. Kumbharkhane, Indian J. Phys., 92(1-3) (2018) 1-6.

[22]A.Mohan, M.Malathi, S.S. Shaikh, A.C. Kumbharkhane, J. Solution Chem., 45(2) (2016) 221–234.

[23] D.N. Rander, Y.S. Joshi, K.S. Kanse, A.C. Kumbharkhane, Indian J. Phys., 90(1) (2016) 67–72.

[24] D.G. Rathod, D.N. Rander, K.S. Kanse, Y.S. Joshi, A.C. Kumbharkhane, Carbohydr. Res., 507 (2021) 108375.

[25]S.O. Nelson, Transactions of the ASAE42(2)(1999) 523–529.

[26]S.O.Nelson, S. Trabelsi, J. microw. power electromagn. energy 50(4),(2016)237–268.

[27]S.O. Nelson, IEEE Trans. Electrical Insulat.26(5) (1991) 845–869.

[28]S.O. Nelson, P.G. Bartley Jr., Trans. ASAE 45 (2002) 1223-1227.

[29]S. O. Nelson, Transactions of the ASAE, 39 (1996) 1475-1484.

[30]S.O. Nelson, J. Non-Cryst. Solids 351 (2005) 2940-2944.

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